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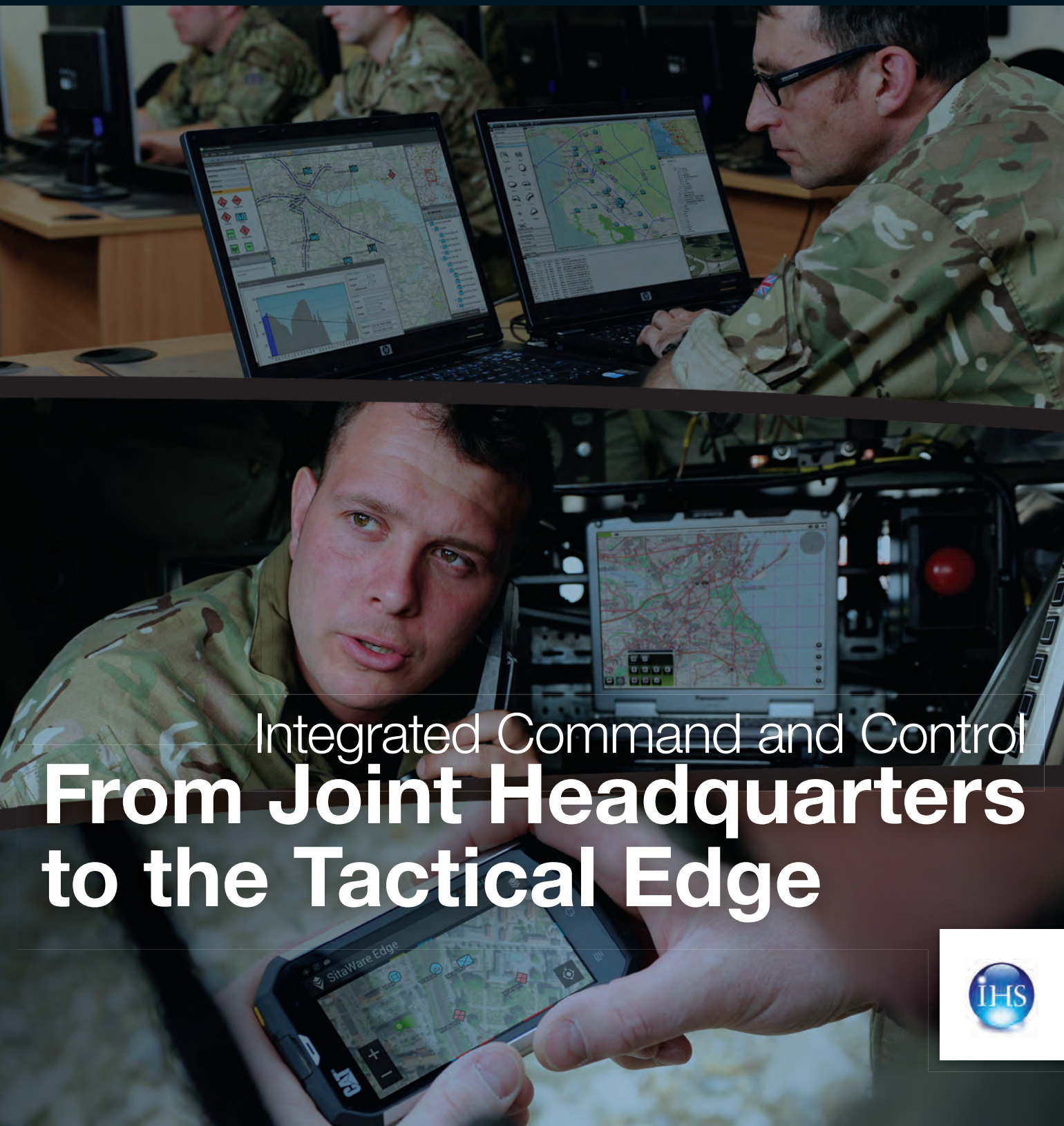


Integrated Command and Control

From Joint Headquarters to the Tactical Edge

From Frontline to Headquarters: a full-spectrum solution

Systematic's interoperable SitaWare C2 software system has been developed over many years with customer requirement acting as the key to the process. **Giles Ebbutt** examines the packages

An effective command-and-control (C2) system must provide the user with an operational picture, support the planning process, and enable the reception, processing, and transmission of information. Central to this is software. One of the more ubiquitous C2 software packages is SitaWare from Danish firm Systematic, which over the last decade and a half has built itself into a position where SitaWare is a key component in a wide range of C2 systems.

Systematic's early work focused on developing interoperable formatted military messaging in the form of its IRIS messaging software, adopted first by the Royal Danish Navy and then by a wide range of other military customers. This led to involvement in the Multilateral Interoperability Programme (MIP), originally established to replace and enhance two previous interoperability programmes, with the objectives of using the Message Exchange Mechanism (MEM) to develop improved structured message (ADatP3) capabilities supporting interoperability of C2 systems and using the Data Exchange Mechanism (DEM) to achieve a data-push capability supporting interoperability and compatible with the common message capability.

The original MIP programme was subsequently combined with the Army Tactical Command and Control Information System (ATCCIS) programme, a separate non-NATO initiative to seek interoperability between automated data systems. The resultant combined programme retained the MIP title.

A number of nations involved in the MIP lacked C2 systems that could exchange data through MIP mechanisms. Systematic, noting this market gap, leveraged its development of the IRIS replication and message exchange mechanisms to develop a standalone C2 product that could work with the MIP replication mechanism, which became SitaWare.

Database replication was carried out using the IRIS Replication Mechanism (IRM) and message replication using the IRIS Organisation Messaging software with MIP extensions, and it was fully integrated with Command and Control Information Exchange Data Model (C2IEDM), which was then the MIP standard. It provided a range of functions, the principal ones being the management of multiple plans and orders including annexes and appendixes; current situational awareness (SA) display and management; an integrated Geographical Information System (GIS) with support for a large suite of tactical graphics, analysis tools, and displays; operational dynamic contract management through IRM; and configuration and administration of the C2 system.

Its use was initially limited to test events within the MIP community, to test interoperability, with its first formal appearance at an exercise in the Netherlands in 2003. However, by 2006 SitaWare had been adopted for operational use by the Slovenian Army as its national C2 system, had been deployed down to platoon level, and had been used in Afghanistan. SitaWare was also incorporated in a Slovenian mortar fire-control system and provided the core of the Romanian Land Forces C2 system (SIAAB).

The Danish Army incorporated SitaWare as the C2 component in its trunk communications network management system (DEOS NMS) in 2004, and in Afghanistan had used it with an interface to Harris HF radios to provide a blue-force

SitaWare Frontline tablet showing a graphic overlay on satellite imagery and the soft function keys along the bottom of the device.

Systematic: 1357000

tracking (BFT) capability. The NMS was subsequently upgraded in 2010.

At around the same time Sweden, as the framework nation, selected SitaWare for use in Nordic Battle Group 8 (NBG 8), on standby as part of the rotational provision of EU rapid reaction BGs for the first half of 2008. NBG 8 included troops from Sweden, Finland, Estonia, Norway, and Ireland. Finland also selected SitaWare as part of its investigations into the development of a network-centric concept, and Bulgaria procured the system for use by its special forces. Systematic subsequently bid successfully for the Finnish MATI II programme, which morphed into the current FINACCIS project.

In 2008 the software was selected by the Spanish Army's Unidad Militar de Emergencias (UME), which provides military assistance for civil emergencies and straddles the civil/military divide, and it entered service in 2009. The UME required a system that provided SA of unit locations along with the ability to issue plans and orders, allocate resources, and manage incidents.

The UME has further customised its SitaWare by building an incident and personnel management system on top of it, drawing on Systematic advice and expertise but with the work being done by software engineers from Indra. The system is of particular use in supporting UME firefighting deployments during the summer, and was also used to support the UME contingent that deployed to Haiti to provide assistance after the earthquake in 2010.

By 2010 Systematic had developed variants with different functionality aimed at different levels of command. SitaWare Portal was intended for the Joint Force or Component level of command and was integrated with Microsoft (MS) Sharepoint. It provided a Common Operational Picture (COP) and comprehensive collaborative planning capabilities, and also included SitaWare Track Server, a data system for collating a variety of land, maritime, and air tracks. This provided the foundations for what subsequently became SitaWare WebCOP.

SitaWare Headquarters (HQ) and SitaWare Battle Management (BM) were designed for different levels of tactical command, with the former supporting the brigade or battalion HQ, and the latter the battalion or company HQ.

Systematic remained closely involved with the MIP programme and SitaWare V4.x supported the MIP Block 2 model, the C2 Information Exchange Data Model (C2IEDM). With the advent of MIP Block 3 (MIP 3.0) and the Joint C3IEDM (JC3IEDM), which was not backward compatible with MIP 2.0, Systematic realised that its customers would be faced with a difficult decision about how and when to move from MIP 2.0 to MIP 3.0.

According to Hans Jørgen Bohlbro, director for business development and sales, C2 systems, Systematic therefore determined to develop a product that would work with both MIP 2.0 and 3.0, and future versions.

"We designed an optimised data model which could encompass all the MIP Blocks, using a system of modular adaptors," he said. "This is more flexible, and future models only need new adaptors." Bohlbro noted that interoperability was fundamental to Systematic's approach to design and development, observing that this was a different philosophical approach to some other manufacturers. "Generally we start from a different position than the mainstream."

Low-bandwidth communication

Systematic also took into account feedback from existing customers in developing SitaWare V5, and came to the conclusion that although SitaWare HQ and BM had the same architecture, the vehicle-borne battle management system requirement was for a lighter, more flexible one, which required a new design. Two separate V5 products emerged, SitaWare HQ and SitaWare BMS.

"One of the things we also recognised as a key development area was the ability to support communications on a low bandwidth, as this was causing a lot of people difficulty," said Bohlbro, "and so we asked ourselves, 'How do you make data-bearing tactical communications easy?'"

The result of these efforts was SitaWare Tactical Communications (STC), which is incorporated into all forms of SitaWare and "provides a communications system that performs well with a very low bandwidth and provides an order of magnitude in performance improvement", claims Bohlbro. "We conducted a pretty wide survey of the marketplace before embarking on the work, and as far as we can tell there's nothing out there that provides this level of performance."

Typical performance characteristics for STC over VHF combat net radio are a friendly force tracking (FFT) latency of an average of 1 minute, with less than 30 seconds for close neighbours and less than 90 seconds across a complete battalion. No point-to-point contracts are needed to exchange information, no end-to-end routing of the underlying network is required, and it works on both IP and non-IP communications.

STC also improves resilience and updating. Although a key element of the SitaWare stable, it is not the result of a single technological breakthrough but rather the sum of myriad small improvements and the incorporation of a variety of technologies, said Bohlbro, who declined to give more detail. The solution

Giles Ebbutt: 1448699

Colt Canada displayed SWORD at the AUSA exhibition with an integrated Android display hosting SitaWare Edge C2 software.

SitaWare Headquarters WebCOP in use.

Systematic: 1521958

works not only on tactical radios, but also on 3G, satellite communications or Tetra radio, and can also be used to tie different networks together.

Following the V5 developments, Systematic then launched its new version of the battle management system at the 2011 DSEI exhibition in London. This is SitaWare Frontline, which remains the current tactical battle management solution.

The software has been constructed in two parts: a vehicle application and a user application. The vehicle application can be integrated with communications equipment, weapon systems, onboard sensors, and vehicle management systems. The user application provides all the Frontline applications and the user configuration software, and can be run entirely independently of a particular vehicle's installation. It can be carried on a memory stick from which it can also be run, enabling a user to move from vehicle to vehicle without needing to install the software and remaining independent of a particular set of hardware.

The memory stick capability is an option, as some security authorities may resist the prospect of allowing external sources to be introduced into a secure tactical system. However, Bohlbro points out that sufficient protection in the form of encryption, anti-tamper devices, specific key recognition, and so on already exists to provide physical protection. In fact, customers had shown more concern about practical issues such as accidentally damaging the memory stick. He asserts "if the business value is there, then you can make the security fit", citing for example the ease of providing updated maps and overlays and written orders at a commander's briefing if they can just be loaded onto a memory stick.

Frontline retains the previous Planning-Execution-Reporting BMS workflow structure, but adds improved installation, maintenance, and training capabilities. It provides BFT and SA. The user interface is centred on the map, with an improved human-machine interface (HMI) principally designed for use with soft keys and a touchscreen, although hard keys and peripherals can be used.

Functions are accessed through a hierarchy of keys. Different map options are available, including satellite imagery, plus the "clip and ship" capability from the SitaWare HQ system, which enables a portion of a map to be transferred into Frontline. Standard APP-6B/MIL-STD-2525 symbology is used. Plans and overlays are transmitted by sending a link to the addresses, so information can be downloaded when required, reducing spikes in network loading.

The system is managed with a deployment and management tool that uses an MS Excel spreadsheet template for planning the network configuration, IP addresses, call signs, and other information, with the deployment tool automatically generating deployment packages.

SitaWare HQ provides more comprehensive C2 functionality than Frontline, with which it is integrated, as it is intended for use at battalion HQs and above. As well as the SA and tactical picture display it provides support for collaborative planning; formal message handling; additional GIS capability, including terrain analysis; and tasking and unit status.

SitaWare WebCOP also emerged during this period, offering a C2 system within a web browser. "It started as a technology demonstrator," said Bohlbro, "but it was so convin-cing that we realised it could provide an excellent complementary capability to SitaWare HQ." The key element is the ability to show the COP against a GIS within a browser. By using Keyhole Markup Language (KML) as a supported export format it enables the COP to be viewed on, for example, Google Earth. It has decoupled access to the COP from the need to have C2 software installed.

This has been married to the capabilities of SitaWare TrackServer, which can manage a large number of tracks, both live and processed, with what Bohlbro describes as a fast update rate. Air and maritime interoperability standards, such as OTH-G, NATO Vector Graphics, NATO Friendly Force Information (NFFI), Link 16, and AIS have all been incorporated using the IRIS Interoperability Gateway, which processes formatted messages, thus providing a joint picture. TrackServer can also be used as a Link 16 Joint Range Extension Gateway.

A joint system

By integrating SitaWare HQ and WebCOP an effective joint system is provided. "WebCOP can be used with a number of web browsers and map backgrounds," noted Bohlbro, observing that the use of common web interfaces such as MS Internet Explorer keeps the training requirement low. Additional menus can be added.

This configuration was integrated with the Combined Enterprise Regional Information Exchange system (CENTRIX), in use by US Central Command and US Pacific Command to allow data exchange between US forces and coalition navies during Exercise 'Trident Warrior 2011'. Also in 2011, the Swedish armed forces deployed SitaWare HQ and WebCOP in Afghanistan as part of their International Security Assistance Force (ISAF) C2 architecture. Track Server and HQ are also integrated into SWECCIS, the tri-service Swedish C2 system.

The HQ/WebCOP configuration was approved for use on the Afghan Mission Network in 2012, and it was also used as part of the project in 2012 to provide the Bundeswehr Joint Forces Operations Command (Einsatzführungskommando – EFK – der Bundeswehr) HQ in Potsdam with a current common operational picture. This included integration of SitaWare HQ with MS

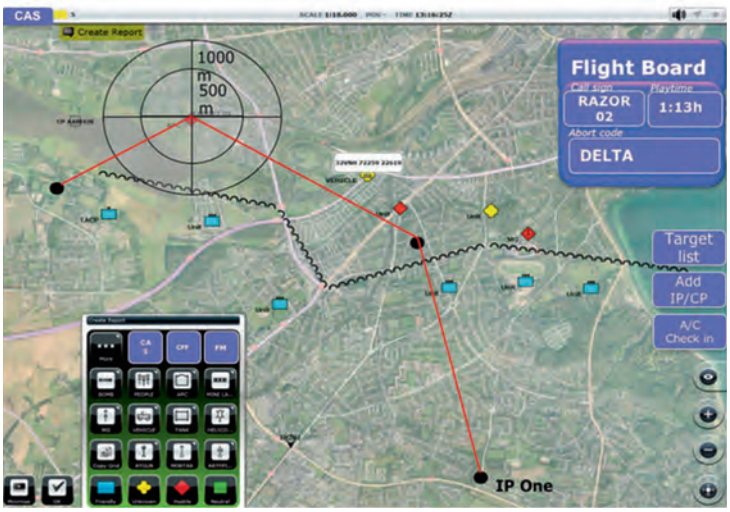
Sharepoint, a solution that had already been provided for another, unspecified, customer.

The United Kingdom utilised SitaWare and the MIP gateway to provide the interoperability solution for its Bowman Combat C2 system. SitaWare is used as a portal between the closed Bowman and external systems. Messages from/to Bowman are translated by SitaWare, enabling the exchange of information.

Throughout this period there had been an intention to produce a dismounted version; many similar initiatives were under way in response to the wide range of dismounted soldier programmes that were in development. Systematic produced a series of versions, some more developed than others. Pocket SitaWare, a Windows CE version, appeared in 2006 and SitaWare Soldier in 2008, although the latter did not get beyond the prototype stage. A version hosted on an iPhone and an iPad was shown at the 2010 Eurosatory exhibition. However, this was only a technology demonstrator; although it worked well, there was no intention to develop a version for IOS, which is a closed environment, and it was not taken further.

There was no lack of customer demand for a dismounted solution, and by 2012 technology had progressed sufficiently in a number of areas to justify further development work. STC was fully developed; small form factor, lightweight rugged Android devices were increasingly available with high-quality displays and low power requirements; and the smartphone-type interface was increasingly acceptable and familiar to the likely user. The result was the Android-based SitaWare Edge, which was revealed at DSEI 2013.

The software provides layered tactical data over maps or imagery, including FFT; an intelligence picture; reporting tools; an integrated compass; alerting functionality; and a command layer for the generation, transmission, and reception of tactical graphics and sketches. The system uses the same compressed map format as Frontline, enabling areas of mapping and imagery to be imported from SitaWare HQ using the "clip and ship" process. An indication on the rim of the display shows the presence of icons beyond the map area displayed on the screen. The system can be set up using the same deployment and management tool developed for Frontline. It can detect the type of device on which it is hosted and will slightly adapt the user interface accordingly.



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A screenshot from SitaWare Frontline showing the additional FAC functionality.

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SitaWare Edge on a small handheld device.

In 2008 the Danish Army had selected SitaWare BM as the tactical system to be integrated under the ill-fated Danish Army CCIS (DACCIS), with an order for 1,000 licences. In 2012 this was then extended to an unlimited number of users with the complete suite including Frontline. In 2013 the Danes then became the launch customer for Edge, with an order to equip junior dismounted commanders, using a hardware configuration of the Harris RF-3590 ruggedised tablet and the Harris RF-7800S-TR secure personal radio.

Bohlbro said that initial feedback on Edge from the Danes and from other customers who had acquired small numbers for trials was overwhelmingly positive. In October 2013 at the Association of the US Army (AUSA) exhibition Colt Canada revealed its Sniper Weapon and Observer Reconnaissance Devices (SWORD) small arms fire-control system. This integrates a ruggedised smartphone-like device hosting Edge with a weapon-mounted scope and laser rangefinder, or other surveillance and targeting devices using Colt's small arms network power data system (NPDS).

The weapon user is therefore able to designate targets and transmit images from the weapon scope to confirm a target or provide surveillance data while having access to other data sources such as imagery from a tactical unmanned aerial vehicle (UAV) and to the wider tactical picture. The system can be used to provide sniper C2 or integrate into a wider C2 system, such as Frontline.

Systematic has added additional functionality to the Edge software to support SWORD, including ballistic calculations to support indirect fire munitions. When the weapon is being used to fire a grenade, if this functionality is enabled, the cross hairs on the display screen will be laid on the target when the weapon is at the correct angle for accurate fire.

Simulation systems

SitaWare has also been incorporated into simulation systems. The BMS was integrated with the Steel Beasts combat simulation environment from an early stage, with entities in the Steel Beasts environment translated into tracks in SitaWare. More recently the Danish firm IFAD has developed a gateway using Distributed Interactive Simulation (DIS) and High Level Architecture (HLA) standards, which enable SitaWare to be integrated with other simulated environments such as Bohemia Interactive Solutions' Virtual Battlespace 2 (VBS2) or MÄK's VR-Forces.

SitaWare HQ has also been integrated with MASA's SWORD command training software. The latter is designed to provide an intelligent

simulation of military activity to support command post (CP) training, with simulated units following doctrine-compliant courses of action once they receive operational orders. CP exercises can therefore be conducted with staff using SitaWare to support operational planning and dissemination of orders, with the tactical picture being generated in the SitaWare display by SWORD software. This provides a commercial off-the-shelf solution for C2 training, course of action analysis, wargaming, and simulation support in concept and doctrine development. It can also simultaneously be integrated at the entity level.

Development of the software suite continues. Frontline has recently been improved by the addition of functionality to support Forward Air Controllers (FACs) in directing close air support (CAS). This includes formatted CAS-requests, ground/air data message exchange, graphical display of the CAS 9-line message, a readout of target information, and integration of the L-3 Soldier ISR Receiver (SIR) video downlink. A lightweight FAC/Forward Observer equipment solution has been devised in conjunction with Black Diamond.

Another development project is the integration of a tactical UAV video downlink with Frontline, for which Systematic used the multirotor Sky-Watch Huginn X1 and successfully provided a video feed into the Frontline display, while showing the sensor footprint on the background map.

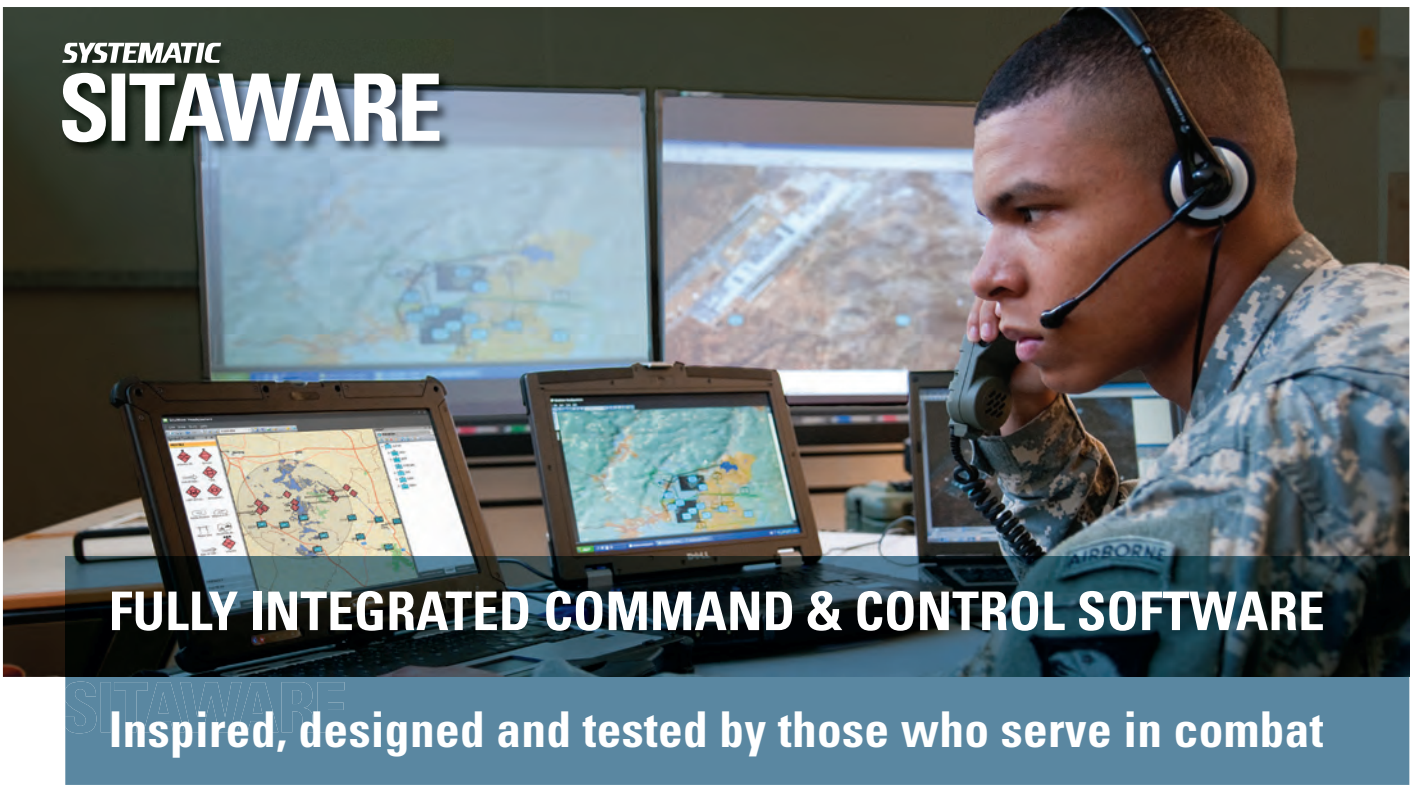
The integration of Frontline with a laser rangefinder has also been improved. If a target is designated with a laser rangefinder, this now appears on the map display, showing the target location and the range and bearing from the lasing vehicle. This can be distributed across the network.

There have also been developments in SitaWare HQ. Recording of activity for briefing and after action reports has been facilitated by the addition of a bookmark function to take a snapshot of the operational picture which can then either be used to brief direct from the C2 system or exported into a separate Powerpoint presentation. Event entries for an operational HQ journal, often a legal requirement, can also now be automatically generated.

Systematic does not intend at present to develop applications within the SitaWare suite for specialist warfare functions, such as indirect fire control, combat engineering or chemical , biological, radiological, nuclear (CBRN). Bohlbro notes that this has been a conscious decision because there has been no demand from customers and the fundamental architecture of the system is based on interoperability; providing existing or future specialist software meets established interoperability standards, it can be integrated with SitaWare. The focus remains on the core of SA, planning, intelligence, and logistics.

Developments for 2014 will include harmonising the messaging capability across all the products, with an application alongside SitaWare Edge which provides text messaging with attachments as already present in Frontline. Having provided an initial MIP 3.1 capability in 2013, Systematic intends to improve the maturity of this early release to provide a fully functional operational capability.

Development thereafter will very much depend on customer feedback; there is no specific roadmap. "We concentrate on functions that most people seem to want and what our customer base indicates is a common requirement. We listen to them and focus on their needs," said Bohlbro. ■



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